Continuing Collaborative Concept Formulation (C3F):

A Proposal to Improve the Ship System RD&A Process and to Re-Invigorate Naval Engineering

Otto Jons, CSC

Steven Wynn, NAVSEA

Background

(a) ONR/NAVSEA Ship Design Process Workshop:

Track C Objectives: "Provide recommendations for a future requirements development process and ship design process …." (Williamsburg, May 2008)

(b) CNO ADM Roughead: Directs Changes to the Process and Organization for Developing New Concepts

(c) SECDEF Initiatives:

(1) Statement: "Initiate material and non-material solutions development in parallel with formal communication of the requirement."

(2) "Adaptive Planning" Roadmap

(d) Personal Observations / Lessons from Past Acquisition Reforms extending over 40 Years

= "Are we missing something fundamental ??"

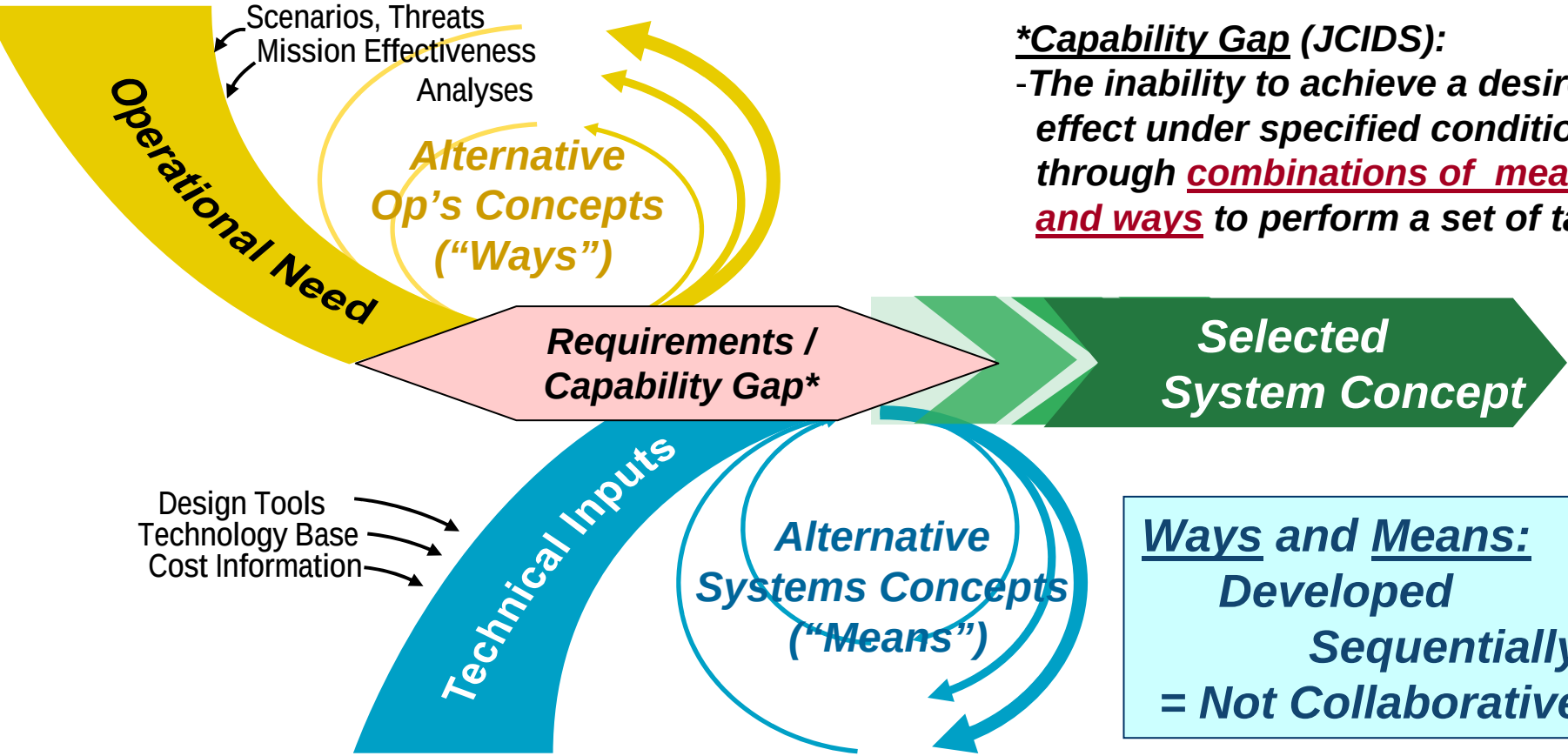
Outline

1. Concept Formulation (CF) Today
2. Why Continuing CF
3. Why Collaborative CF
4. Summary

Concept Formulation Today:

Step 1. Develop Requirements / Identify Capability Gap

Step 2. Develop the System Meeting those Requirements

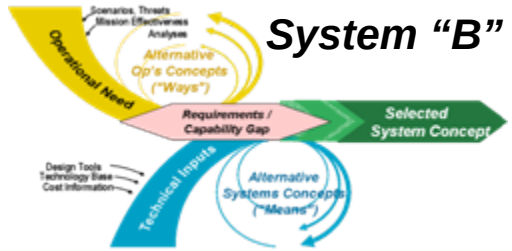


***Capability Gap** (JCIDS):*
-The inability to achieve a desired effect under specified conditions through combinations of means and ways to perform a set of tasks.

***Ways** and **Means**:*
Developed Sequentially
= Not Collaboratively

Concept Development - Today

1. Since Not Collaborative:



Requirements are finalized before the System Concept is fully defined:

- *Without a System Definition, i.e., a "Means" Solution:*

➡ *No Valid Cost Estimate for New, Advanced Systems,*

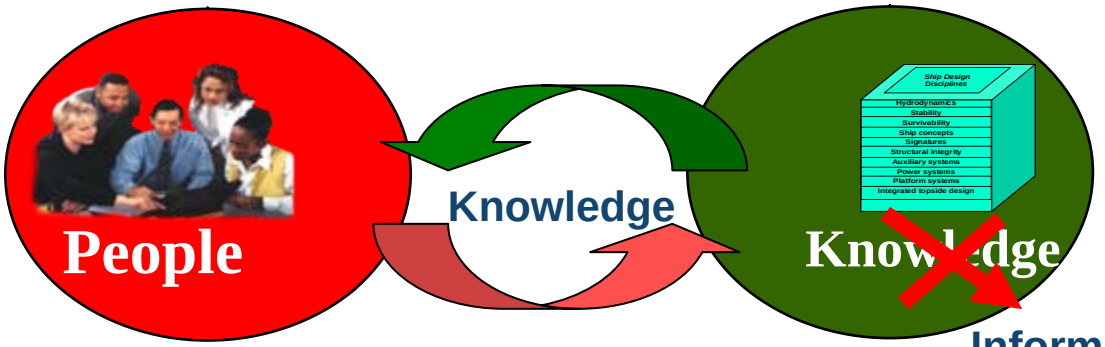
➡ *No True "Quality – Quantity" Trade-Off*

➡ *No Meaningful "Ways & Means" Trade-Off*

2. Not: Continuous:

Design Teams are disbanded
- *once Design is completed*
- *and/or responsibility is transferred to a Contractor*

Knowledge & Readiness



Information

→ "Knowledge Currency "

- ***People retain their qualification, i.e., their knowledge, only by <u>continuing practice</u> of their trade;***

= especially important in Complex Naval Ship Design involving extensive knowledge sharing.

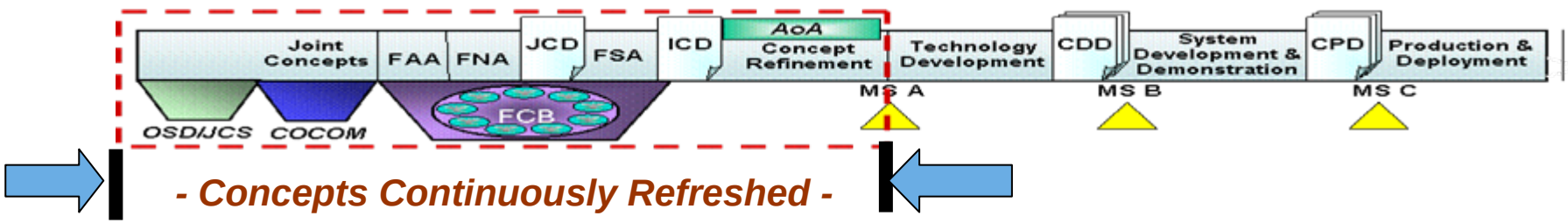
- ***There cannot be effective workforce development or <u>readiness</u> without continuing practice!***

- ***Similarly: Tools – even if Validated - still Require <u>People Trained</u> in Using Them!***

Why Continuing CF?

1. *Continuing CF results in mature System Concepts, ready for Refinement and Acquisition;*
2. *This is achieved by Design Teams, continually practicing their trade, i.e. attaining a high degree of Proficiency & Readiness.*
3. *Systems can be developed with accurate, real-time awareness of Cost Consequences.*
4. *There are continuous opportunities to*
   - *Incorporate Lessons Learned from past designs*
   - *Transition new S & T results and innovative operational concepts*

Finally: It can drastically reduce a Multi-Year Process:



Collaborative Concept Formulation

The Components:

Operations Concept Formulation ("Ways")

Material Concept Formulation ("Means")

Capability

= Collaborative

Applied to:

The Fleet

and

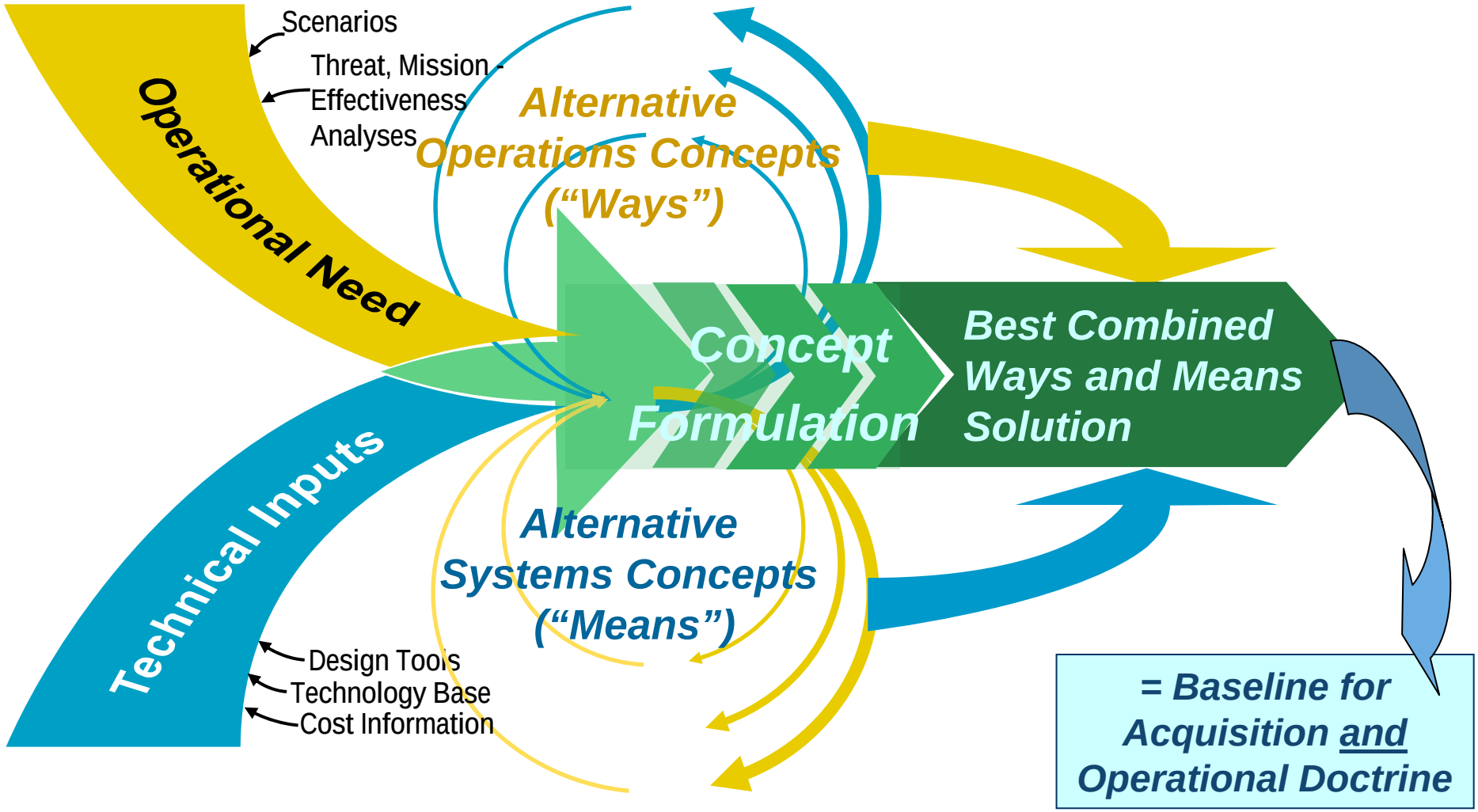
Indiv. Ship Systems

Current Fleet		***< 5-6 Yrs.***
The Next Fleet		***~ 15 Yrs.***
Future Fleet		***~ 30 Yrs.***

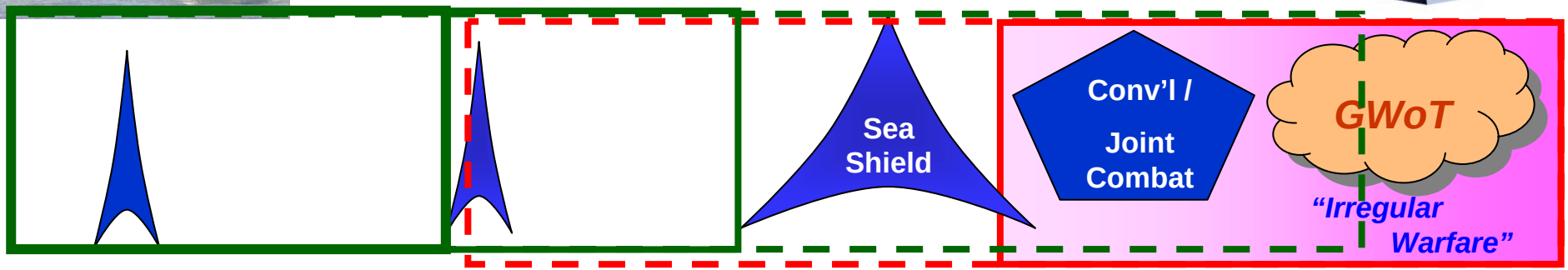
Fleet Composition: ***= Existing Ships*** ***= New Ships / Systems***

Goal: ***Aligning Individual Ship Requirements with Fleet Needs***
By Optimally Matching
Fleet / Operational Concepts and (New) Ship System Performance
(Ways) ⟷ (Means)

Collaborative Concept Formulation (How)

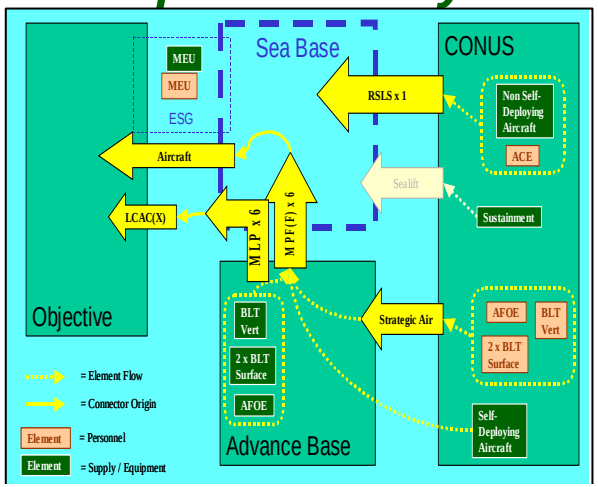


Naval Systems – A Special Case



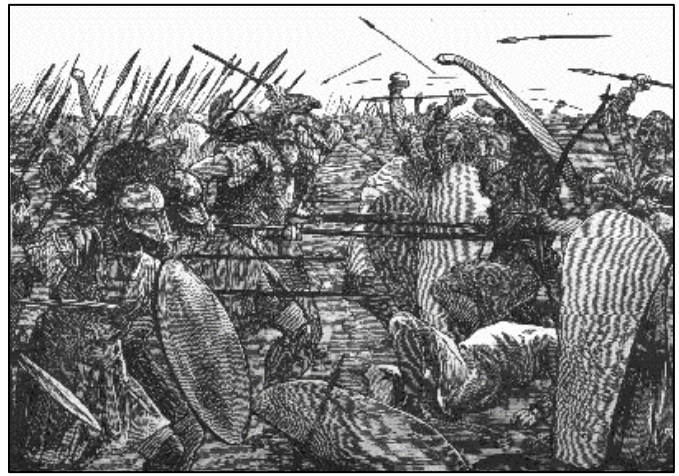
Navy Missions

Transportation Systems



"Ordnance on Target"

Warfare Systems



System of Systems in Natural Environments

Naval Ships:

Hybrid Engineered Systems

Complexity & Adaptation:

Complex Adaptive Systems (CAS)

Mission - / Warfare Systems

Hull/Platform: A Transportation System

From Systems to Effectiveness

Mission - / Warfare Systems

Hull/Platform: A Transportation System

Effectiveness in Transportation

Shuttle Ship :

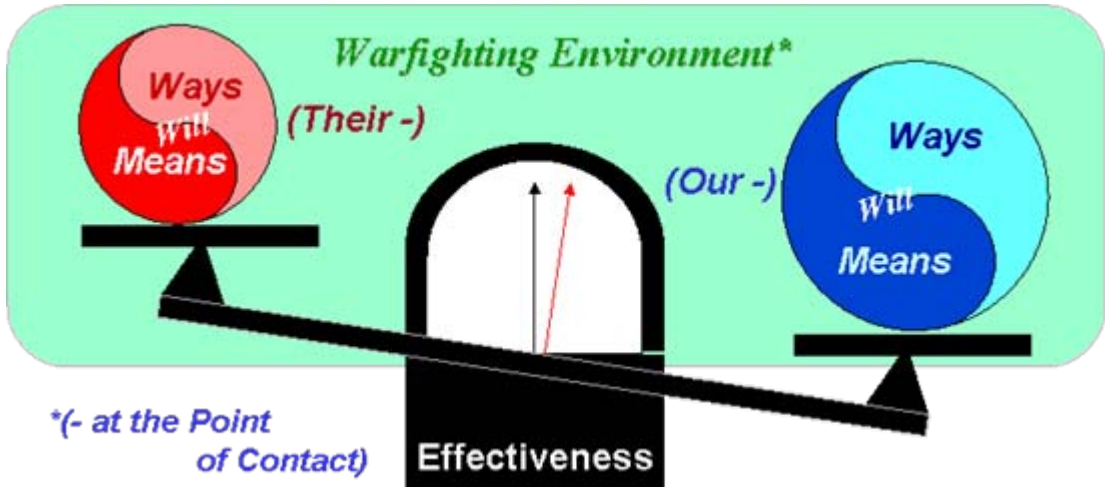
$$E = \frac{P \times D}{T_L + D / V + T_U}$$

Where:

- Payload (P)
- Distance (D)
- Time (T) to Load / Unload
- Time to Transit (= D/V)

System (Means) Performance Directly Impacts Effectiveness

Effectiveness in Warfare



System Performance is only one of the seven Parameters with Countless Variables

Optimizing Effectiveness in Warfare Mandates Exploration of the "Ways & Means" Trade-Space

Note: Dominance in One Domain Forces the Adversary into Asymmetries

= Warfare: The Ultimate Complex Adaptive System (CAS)

Why Collaborative CF?

1. *Collaborative CF gives Customer/Operators continuing Feedback on*

   - the Impact of Requirements on both Capability and Cost, and

   - Evolving Opportunities for Advancing Technology

2. *It gives the Designer Feedback on the Impact of Performance on Capability*

3. *It enables Quicker Adaptation to Changing Needs*

4. *Most important: Collaborative Concept Development*

   > Opens the "Ways & Means" Trade-Space and

   > Enables Optimization of Effectiveness,

   - rather than Optimization of Means for given Ways

C3F Vision

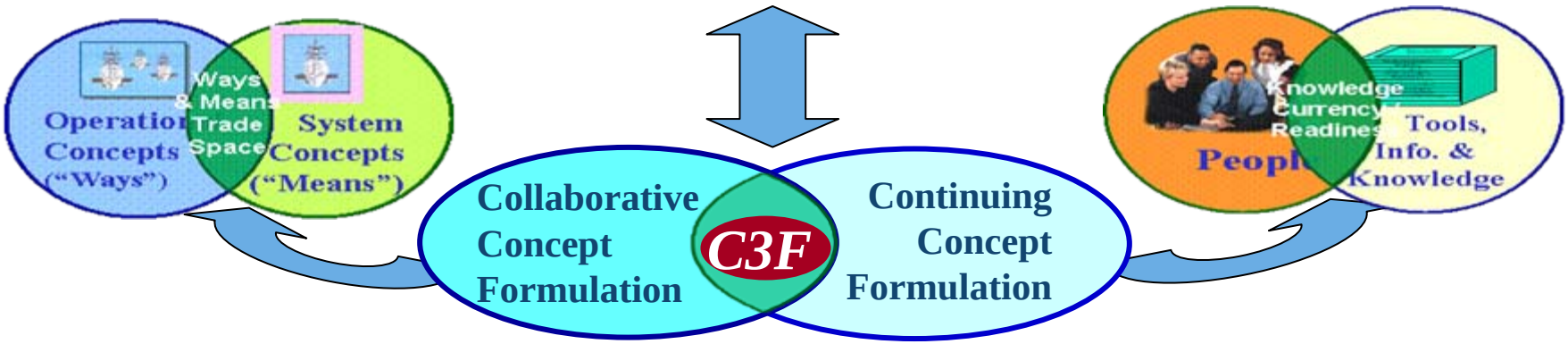
Industry	DARPA	ONR	SPAWAR	NAVAIR	NAVSEA/ NSWC / NUWC	SSG	NWDC	OPNAV	ONI	MCCDC	JCS
Platform and systems	S&T	S&T	Battleforce C^4I	Aviation Concepts	Ship Concept Design/R&D	Future Capabilities	Fleet, CONOPS,	Strategies Fleet Arch	Threat INTEL	USMC Strategies	Joint Strategies

Operations / Warfare Concept Development Centers

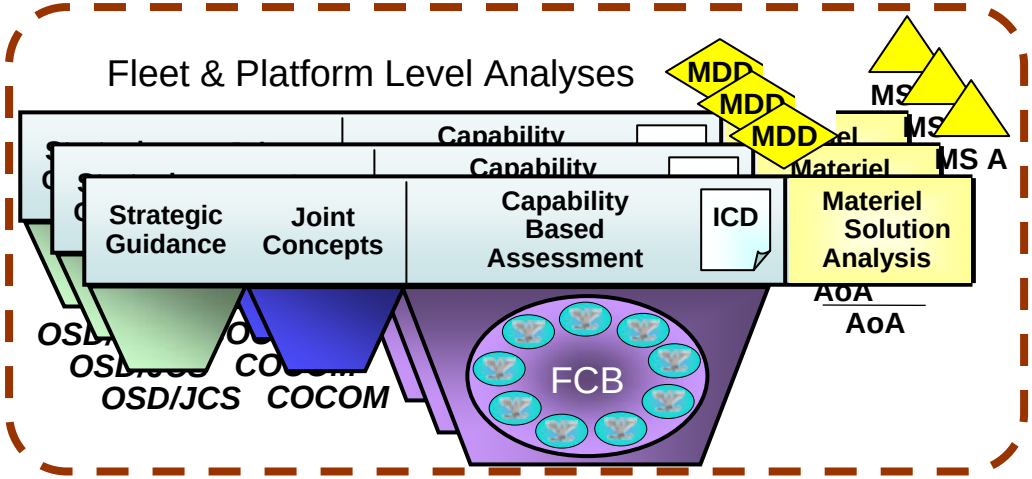
- *Virtual Collaboration Environment*
- *Regular Reporting Cadence*

Ship Concept Development Centers

- *Modeling & Simulation*
- *Visualization Tools*



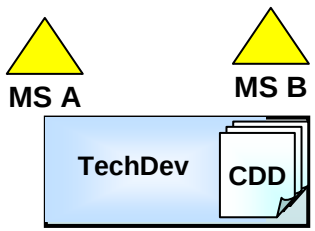
Fitting Into the Acquisition System



Continuous Collaborative Concept Formulation (C3F)

Deciding what systems to acquire, and how they will operate...

i.e., Defining the Means Solution, not just Performance Requirements

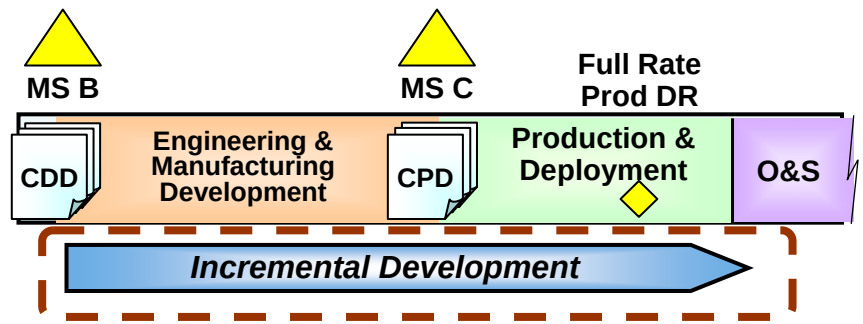


Concept - to - Contract

- *Defining solution to greater detail*
- *Deciding who should build it*

Contract - to - Capability

- *Developing final details*
- *Building*
- *Testing*



Benefits

Operations Concept Formulation ("Ways")
→ **Capability Concepts**
Material Concept Formulation ("Means")

Continuing Collaborative Concept Formulation (C3F)

1. Radically improve requirement setting
2. Rapidly adapt to changing warfighter needs
3. Decrease cost, schedule, and performance risks
4. Effectively transition new S & T results and innovative operational concepts
5. Drastically shorten the Acquisition Process
6. Support workforce development and design resource readiness

Achieve: - Designer Competency and Proficiency
- Requirement Elucidation vs. Imposition

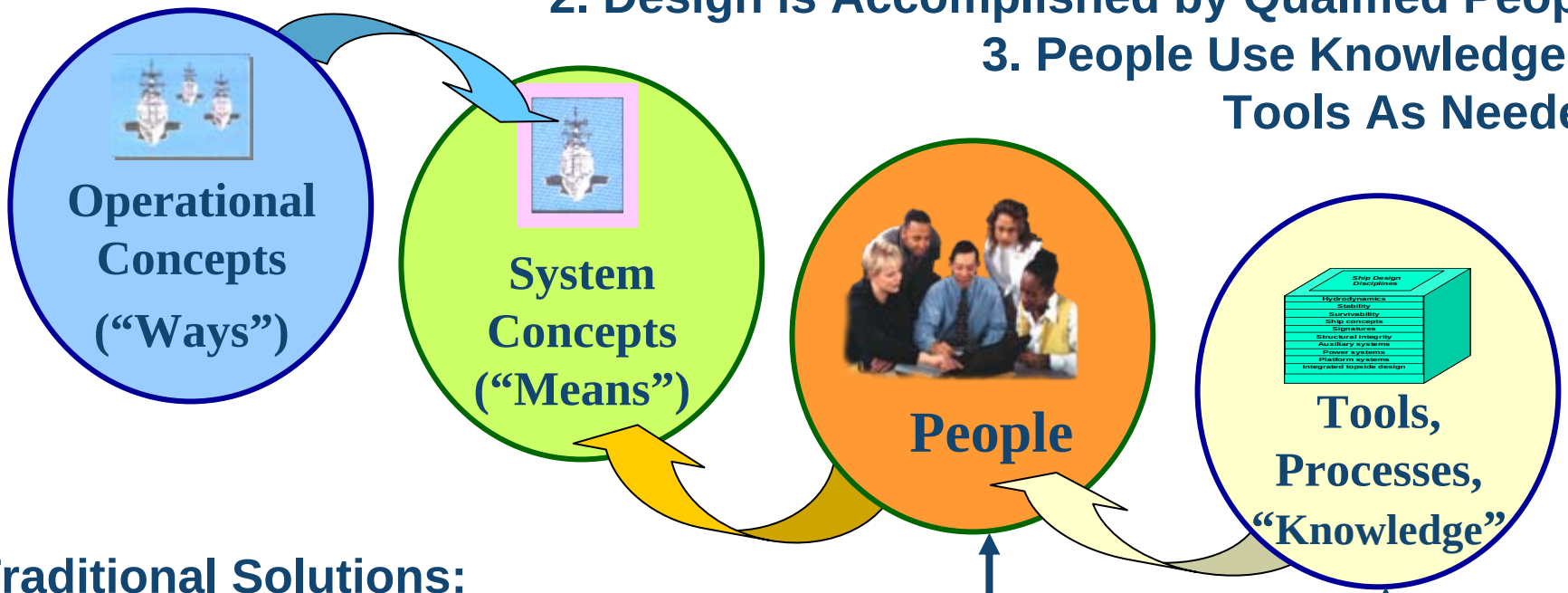
Making C3F Happen

1. **Socialize** the Concept
   - A. Briefing Road Show
   - B. Ship Design Process Improvement Workshops
   - C. Professional Society Presentations
2. **Formalize** Collaborative Relationships
   - A. Leadership Directive
   - B. Memorandum of Understanding
3. **Implement** the Concept
   - A. Align Resources
   - B. Enable Continuity
   - C. Establish Training

Questions

Design:
- The Traditional View

1. Operational Requirements Drive System Design
2. Design is Accomplished by Qualified People
3. People Use Knowledge & Tools As Needed



Traditional Solutions:

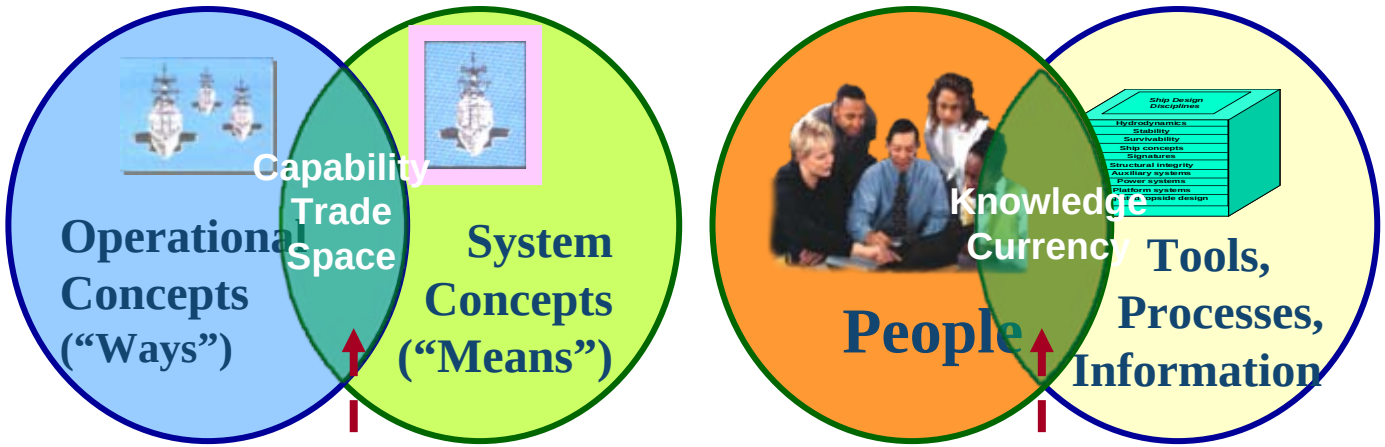
1. Work Force / Manpower Development
2. Design Resource Development

This View does not Address very Important Interactions

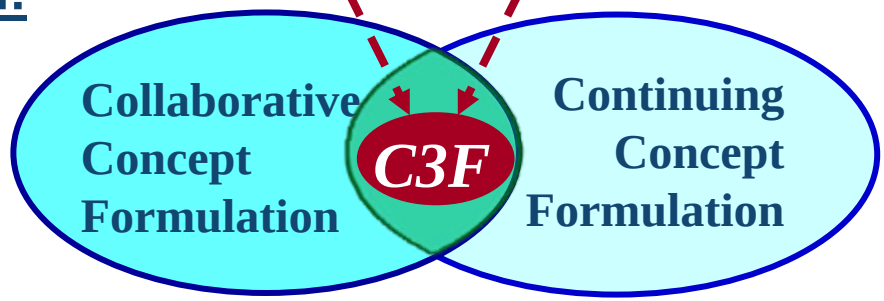
Interactions: - Largely Overlooked

I. Requirement Generation / System Design

II. Work Force Development / Design Resource Development



Proposed Solution:



Capability ("Ways & Means") Trade Space

New Concepts:

Knowledge Currency / Resource Readiness

Continuing Collaborative Concept Formulation (C3F)

Workshop Planning

Plannery Session

Collaborative Concept Formulation | C3F | Continuing Concept Formulation

Operational Concepts ("Ways") | Ways & Means Trade Space | System Concepts ("Means")

"Ways & Means" Trade Space

People | Knowledge Currency / Resource Readiness | Tools, Info. & Knowledge

Knowledge Currency / Resource Readiness

Requirement Generation / Concept Formulation

Retaining Design Resource Readiness

Ship /System Design

Work Force Development

Design Resource Development

Operational Concepts ("Ways")

Platform | Payload

Attract & Retain | Develop & Train

Tools | Processes & Methodologies | Information & "Knowledge"

Interoperability & IDE

Workshop C3F-A: Collaborative CF

Workshop C3F-A: Collaborative CF

"Effectiveness" in Warfare

> **Means** = Material – (Ships, Weapons) & Human – (Personnel, Training)

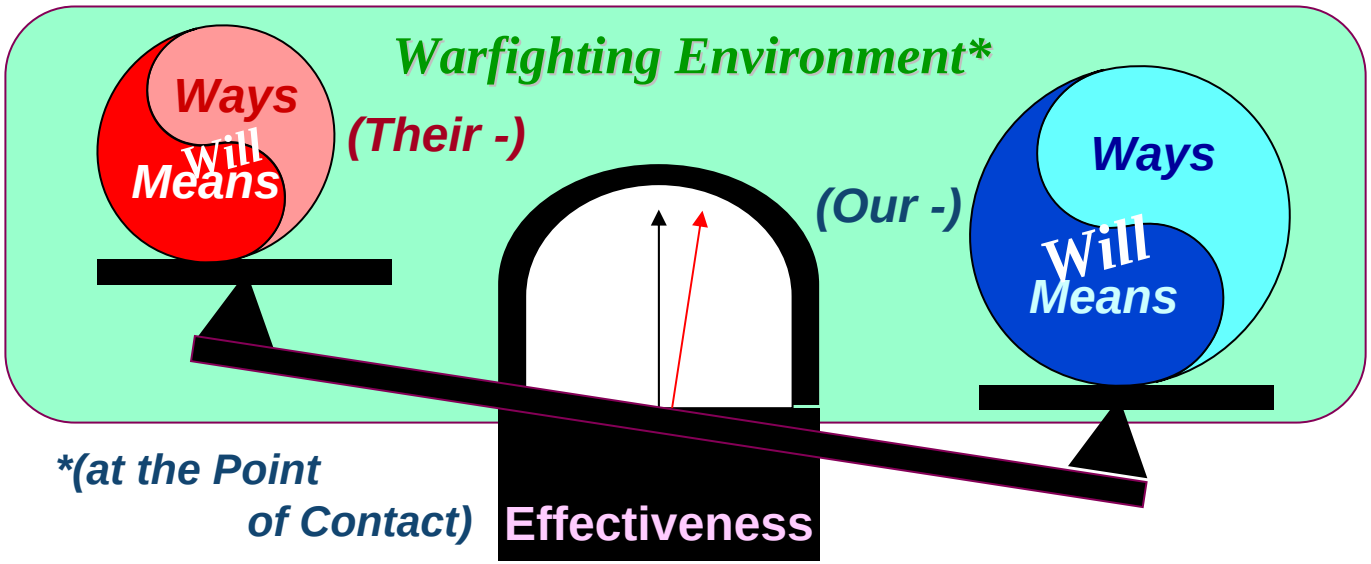
→ Total System Performance

> **Ways** = Strategies, Tactics, Doctrine, Concepts of Operation

> **Capability** = The ability to achieve a desired effect under specified standards and environmental conditions through combinations of Means and Ways

(Another important factor, **Will**, is not addressed herein)

> **Effectiveness:**



The Keys:

1. A Favorable W/M/W/E Imbalance @ the Point-of-Contact
2. The Nature and Speed of Adaptation (OODA)

(1) Concept Development Centers of Excellence

Collaborative

System Concept Formulation ("Means")
→ Capability Concepts
Operations Concept Formulation ("Ways")

Continuing

Operational Concepts ("Ways")

Ways
Means

Technologies & Systems ("Means")

Virtual Environment Systems Simulation Laboratory (VESSL)

Operations/Warfare Development Center (NWDC)

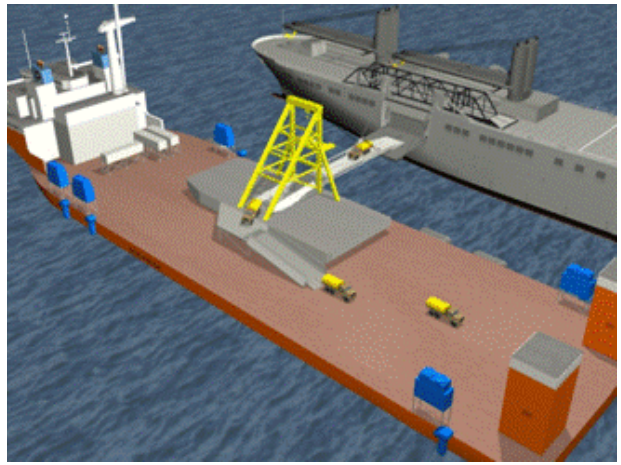
Ship Concept Development Center (SCDC)

(2) Advanced M&S and Visualization for Collaboration and Virtual Co-Location

2. Virtual Environment Systems Simulation Laboratory (VESSL)

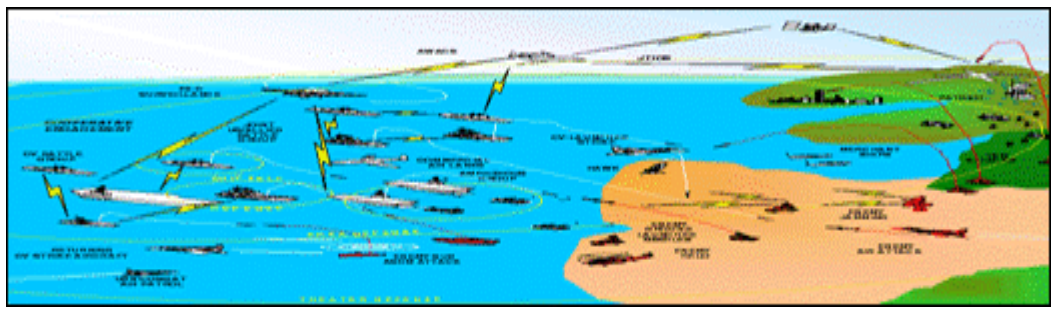
VESSL will consist of:

1. ***internetted simulations that represent activities at a high level of realism.***
2. ***created by a confederation of computers***
3. ***connected by local and wide area networks, - secure, if warranted***
4. ***augmented by realistic special effects and physics-based behavior***
5. ***- if desired, total immersion into the environment being simulated***

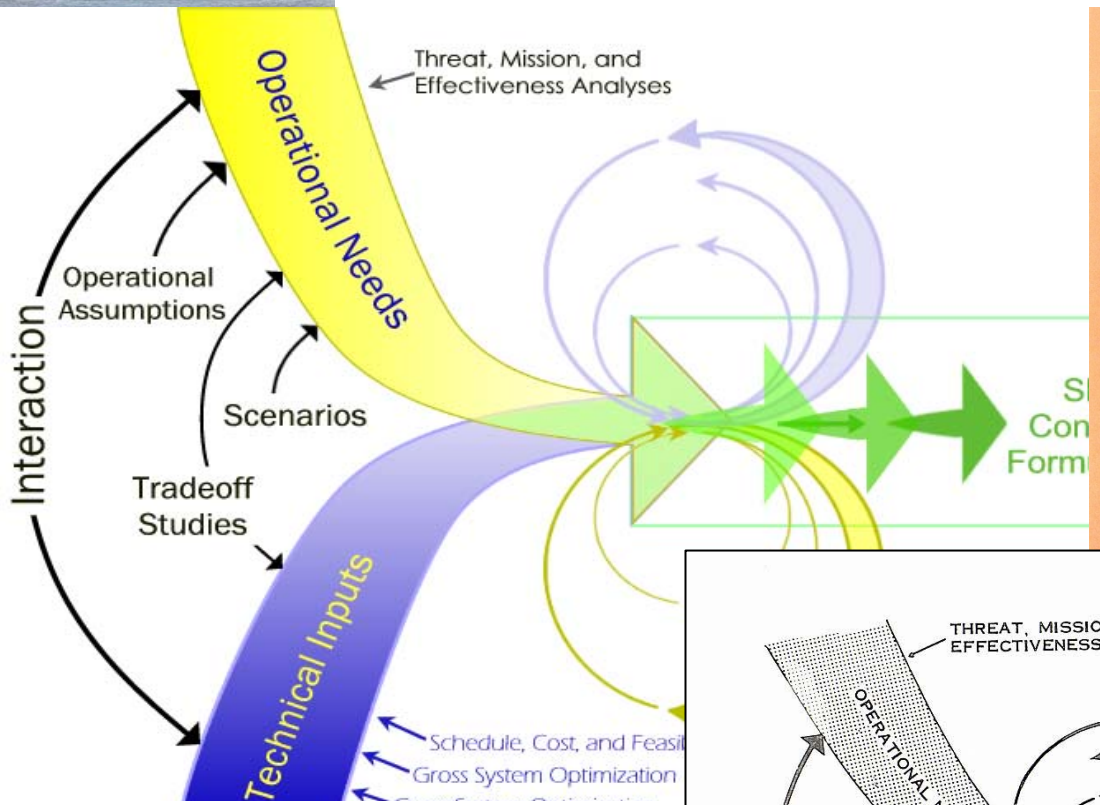


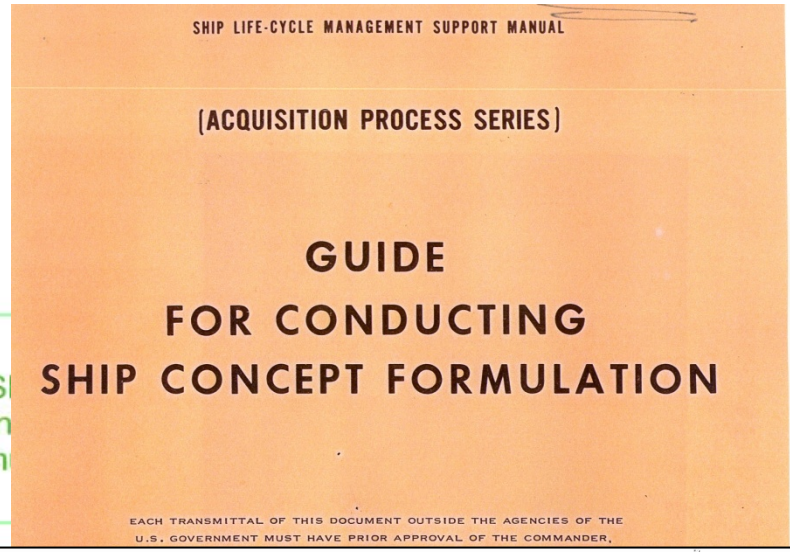
Current Fleet and Virtual Prototypes of New Designs:

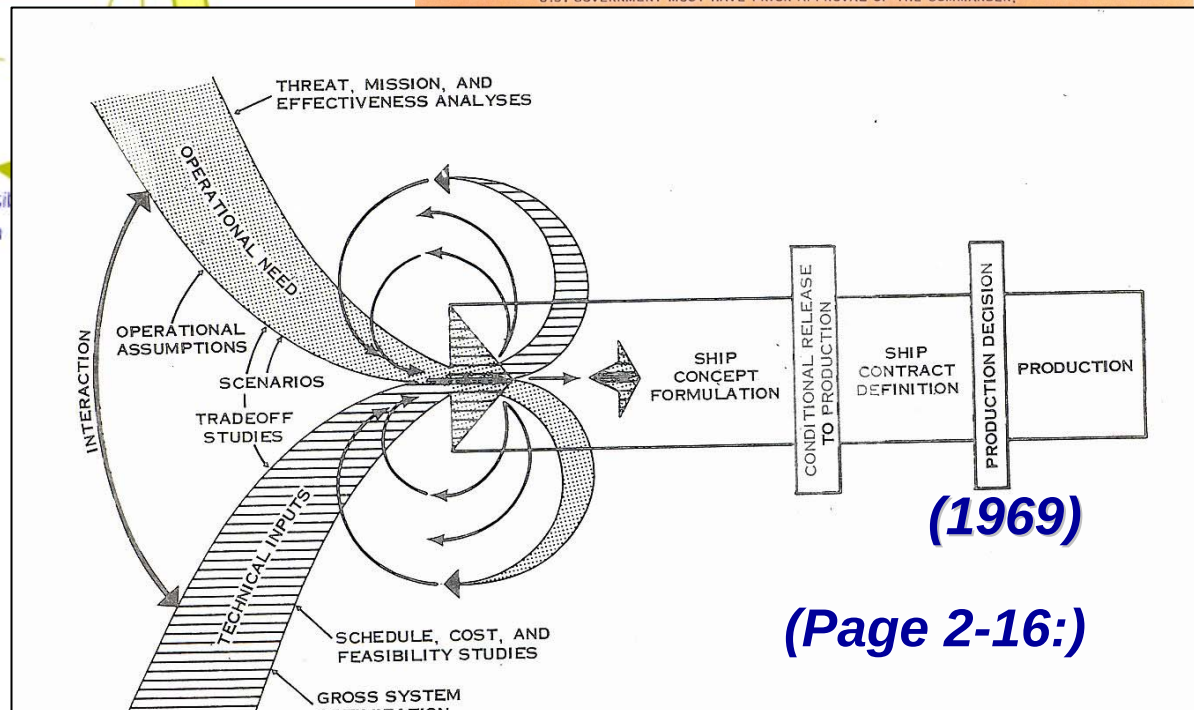
= Created in VESSL & Evaluated by Operators during Design



Solution – Based Acquisition





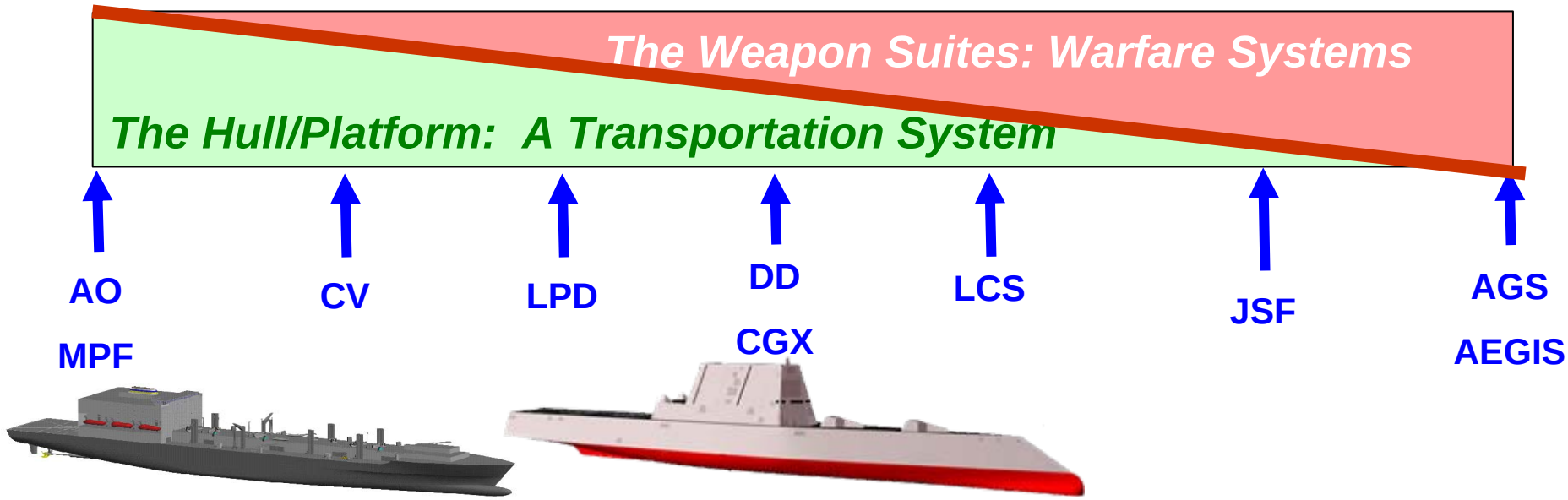


(1969)

(Page 2-16:)

Naval Ships and Systems

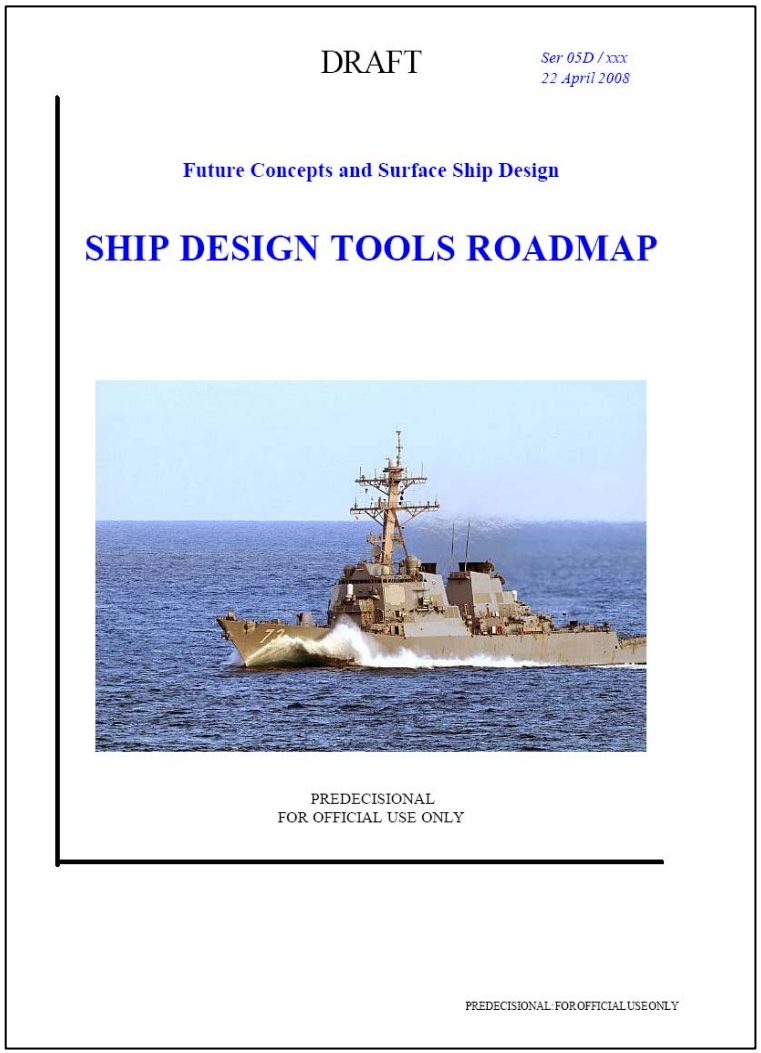
- ***Naval Ship Platform may <u>carry</u> Warfare Systems and/or Hybrids (to Varying Degrees)***



Therefore:

- ***<u>Decouple</u> Payload & Platform:***
  - ***= Easily done for <u>Embarked</u> Systems***
  - ***= For <u>Installed</u> Systems: Use Modularity & OSA***

Ship Design Tool Roadmap



Outline